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U.S. DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN

OF THE

BUREAU OF STANDARDS

ISSUED MONTHLY

BUREAU OF STANDARDS
MAY 5 1934
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Washington, April 1934—No. 204

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HAIRSPRINGS OF WATCHES

In RP670 in the April Journal of Research the performance of watches having the usual cut, bimetallic balance wheels, and steel hairsprings is compared with that of watches having uncut, monometallic balance wheels and elinvar hairsprings. The latter combination of vibrating assembly is a new application intended to improve the general performance of watches.

Twenty watches of each type, 10 each of 2 makes, were given performance tests at temperatures encountered in ordinary use. The temperature-rate errors of the watches having the new vibrating assembly were less than those for watches having the ordinary assembly, and, instead of the usual parabolic curve, a curve approaching a straight line was obtained. Marked improvement in performance at temperatures within the usual range 0 to 50 C is indicated by the use of the new assembly.

The new assembly almost entirely overcomes the effects of magnetism, so that, after the watch is removed from a magnetic field, the rate is not subject to fluctuations experienced with the ordinary assembly.

There is no evidence of any marked difference in performance of the two types of watches in different positions or for isochronism.

FIRST SPECTRUM OF TANTALUM

Although the element tantalum has been known to chemists for over a century, it is only in recent years that it has been prepared in quantity in its uncombined state, largely through the efforts of Dr. C. W. Balke of the Fansteel Co. Tantalum possesses many physical and chemical properties which, through the role they play in the arts and industries, have made it a very useful member of the family of metals. Modern analytical methods require a knowledge of the atomic energy states of an element, and this can be obtained only from analyses of the term structures of the spectra emitted by the element in its various states of ionization. The collection of the necessary data for the solution of such a problem is part of the program of the spectroscopy laboratory of the Bureau. In the case of tantalum much of the experimental work has been completed, but much yet remains to be done in the way of calculation and analysis. As a first contribution toward the completion of the work a description has been published in the April number of the Journal of Research (RP671) of the spectrum emitted by neutral or un-ionized tantalum atoms when they are excited by the arc in air. The electrodes used in this work were cut from a rod of the

metal prepared by Dr. Balke and presented by him for this investigation. More than 2,100 wave lengths of tantalum lines have been measured in the interval extending from 10,300 A in the infrared to 2,300 A in the ultraviolet. This spectrum is superposed on an extensive band spectrum emitted by molecules of tantalum oxide which are always present in the light source. Many of the tantalum lines appear as narrow rectangles and show evidence of being composed of several closely packed lines. Hyperfine structure of this type has been recognized and measured for many of the elements, and from it important information about the nucleus of the atom is derived.

OPTICAL AND CRYSTALLOGRAPHICAL PROPERTIES OF THE ALKALI ZINC URANYL ACETATES

Zinc uranyl acetate has been found to be a useful reagent in the quantitative determination of sodium. Lithium interferes with the determination of sodium with this reagent because it is precipitated with the sodium in such a way that it cannot be separated from the sodium compound. Although the potassium compound may also be precipitated at the same time, it can be separated from the sodium compound by proper treatment. The optical and crystallographical properties of the sodium, lithium, and potassium zinc uranyl acetates were determined at the Bureau to ascertain their relation to the chemical behavior of the salts. As set forth in RP672 in the Journal of Research for April, lithium and sodium zinc uranyl acetates are similar in crystal form and optical properties and are completely miscible in the solid state, while the potassium salt is quite dissimilar.

STANDARD ABSORPTION CURVES FOR SPECIFYING THE QUALITY OF X-RADIATION

In an X-ray beam there is a proportionality between the energy and the strength as measured in roentgens, only for radiations of the same effective spectral distribution. Comparison with the copper and aluminum absorption curves produced by constant potential has been established as a means of equating the qualities of X-ray beams excited by various voltage wave forms. In the April number of the Journal of Research (RP666) there is set up a set of standard absorption curves for copper up to 180 kv (constant) and aluminum up to 110 kv (constant). Accurate evaluation of the wall absorption of the tubes used permits the establishment of basic absorption curves. Similar curves are set up at potentials from 250 to 550 kv (constant), using a tube having 6 mm of copper filtration. The effect of wall absorption on the relative position of the absorption curves is discussed, and it is shown how a single curve may be used for a complete and adequate specification of X-ray quality. No other quality specifications are adequate without auxiliary information.

THERMAL CONDUCTIVITY OF METALS

It is a familiar fact that metals are good conductors of heat and that certain metals, such as copper and aluminum, conduct heat much more readily than other common metals, such as iron and steel. Numerical data on the heat conductivities of various metals and alloys have important theoretical and practical applications. RP668 in the April number of the Journal of Research describes a method and apparatus for the accurate determination of thermal conductivities of metals and alloys up to a temperature of 600 C (1,112 F).

In the method employed the conductivity of a metal is compared, either directly or indirectly, with that of lead. Lead was selected as the standard, since previous measurements have established its conductivity within fairly close limits. Determinations are made by measuring the axial temperature gradients in two cylindrical bars soldered together, end to end, one end of the system being heated and the other cooled, and the convex surfaces protected from heat loss by a surrounding guard tube.

To determine the accuracy of the apparatus, a series of experiments was made with three metals, lead, zinc, and nickel. The conductivity of each metal was compared with that of each of the other two, and all results obtained were consistent within 2 percent.

Data are also given in the paper on the thermal conductivities of several commercial nickel chromium and other alloys widely used for electric heating elements and thermocouples.

THERMAL CONDUCTIVITY OF IRONS AND STEELS

Most of the researches on the thermal conductivity of metals were made in an attempt to correlate their thermal and electrical conductivities. There have been surprisingly few de-

terminations of the thermal conductivity of irons and steels, the most widely used of all metals. While the actual thermal conductivity of a structural metal may seldom be the most important factor to be considered in selection or design, the thermal conductivity of structural materials over a range of temperature is of considerable importance in many instances.

The Bureau has recently completed determinations of thermal conductivities of 20 miscellaneous irons and steels over the temperature range 100 to 500 C (212 to 932 F). The materials were selected as typical examples of commercial materials used for a variety of purposes and were expected to differ considerably in thermal conductivities. They included cast irons, carbon and low-alloy steels, high chromium and manganese alloy steels, and "18–8" type of stainless steel.

The results, which are published in the April Journal of Research (RP669), show that the differences in conductivity of irons and steels are much smaller at high temperatures than at room temperatures. High-alloy steels have lower thermal conductivities than low-alloy steels. An increase in the amount of alloy constituents in iron causes, in general, an increase in the temperature coefficient of thermal conductivity.

CREEP OF METALS AT ELEVATED TEMPERATURES

Solid metals may flow or "creep" if they are subjected to a constant or continued load, which behavior is particularly noticeable when the metal is at a temperature above normal atmospheric temperature.

In studying the creep of metals, the Bureau has prepared single crystals of silver and has been measuring the very slow flow or creep of these single crystals when sustaining constant loads at 400 C. With this type of specimen the influence of the grain or crystal boundaries on the creep of metals is eliminated. Some of these single crystals have now been under load and slowly creeping for over 9 months. The rate of creep of a silver crystal at 400 C is influenced by the direction of the stress in the crystal relative to the crystal axes. The rate of creep is relatively low when the load acts in a direction approaching that of a perpendicular to the cube face of the silver crystal. The rate of creep is distinctly higher when the crystal is loaded in a direction making an angle of 30° to 45° with this same perpendicular.

WEATHERING OF SHEET ALUMINUM ALLOYS

The investigation of the corrosion of aluminum alloy sheet materials has been in progress at the Bureau since 1925. Its purpose is to study and develop methods for the elimination of corrosion embrittlement in the alloys utilized in aircraft, more particularly duralumin.

Extensive laboratory corrosion tests, supplemented by actual exposure of specimens to the weather at Washington, D.C., Hampton Roads, Va., and Coco Solo, C.Z., have furnished data on the behavior of these materials under conditions conducive to corrosion.

Corrosive attack of the intercrystalline type is most undesirable in sheet aluminum alloys, since it results in serious embrittlement. The attack is particularly insidious because it may be difficult to discern on the surface even when it has penetrated the metal deeply, following the path of the crystalline, or grain, boundaries. The results of tests have indicated that intercrystalline attack in sheet duralumin may be practically eliminated if certain procedures are followed in heat treating the material. The heat treatment recommended involves heating at a temperature closely approximating 505 C and quenching quickly in a medium conducive to rapid cooling, such as cold water.

Reheating of heat-treated duralumin at temperatures between 100 and 300 C renders the material susceptible to the intercrystalline attack. This attack tends to penetrate sheet duralumin much more rapidly than the usual pitting. The latter develops in material which is properly heat-treated and tends to spread on the surface rather than to penetrate. Losses in the tensile properties, after the same length of time of exposure to the weather, are much greater with material that is susceptible to the intercrystalline attack than with material on which only pitting is present.

Slight differences in chemical composition or small amounts of cold working are less important in influencing the rate of corrosive attack than is the method of heat treatment. Invariably corrosive attack, as evidenced by the loss in tensile properties, proceeds at its most rapid rate within the first 2 years of exposure to the weather. Thereafter, to the conclusion of a 5-year exposure period, further losses in tensile properties were seldom in evidence.

Saline or marine conditions of exposure resulted in a much more rapid initial rate of corrosive attack and indicated the need for protective coatings under these conditions. Surface coatings of high purity aluminum, especially those of a type integrally alloyed to the base metal of the sheet, served excellently in retarding corrosion under severe conditions.

The general conclusion arrived at as a result of the tests was that aluminum alloy sheet materials are to be regarded as thoroughly reliable from the standpoint of their permanence in service, provided proper precautions are taken to render them corrosion-resistant.

CORROSION SURVEY FOR PIPE LINES

The most economical way to reduce corrosion costs on a pipe line is to apply the proper kinds of protective coatings to those parts of the line where corrosion is the most severe. In the construction of the line it is therefore necessary to have some means for locating these places. In a paper entitled "Corrosion Surveys for Pipe Lines and Distribution Systems", presented at the distribution conference of the American Gas Association in Detroit on April 10 by Scott Ewing, an attempt is made to determine whether or not any of the methods which have been proposed for locating corrosive soils are sufficiently reliable to be recommended for general use. These methods may be divided into 3 general classes: (1) electrical methods, in all of which the soil resistivity is the most important factor; (2) chemical methods, of which the measurement of soil acidity is the only one considered in this paper; and (3) soil classification methods, which include field examination of the soil, the topography, drainage, vegetation, etc.

A method of treating the data has been devised whereby, with assumed coating and repair costs, the saving which could have been affected by coating certain parts of the line at the time the line was laid can be determined. Any of the proposed survey methods may be tested on an old line the corrosion history of which is known.

The data upon which this report is based include superficial surveys of 2 large gas distribution systems and a rather detailed survey of about 1,000 miles of transmission lines, for which accurate repair records had been kept.

The results show that the most accurate method for making a corrosion survey includes mapping the soil types and collecting samples upon which acidity and resistivity measurements are made.

The report describes the procedure to be followed in making the survey for a new pipe line, and the method of determining where coatings should be applied. It is believed the method could be used in most midwestern, eastern, and southern soils, but it will certainly require modification in western soils.

COMPRESSION CUTTING TEST FOR RUBBER

A common method of measuring the quality of a rubber product is to make tensile strength and stretch tests on specimens of the rubber used. For products such as rubber bands, these tests are closely related to actual service, but for many rubber products, such as insulated wire, hose, and tires, the tests have only an indirect bearing on the performance in service.

In an attempt to make a test which would approximate the conditions encountered in use by many rubber articles, and at the same time simplify testing, a compression cutting test was suggested by the Bureau. This test consists of compressing a sample of rubber to failure between a flat plate, or anvil, and a cutting tool and recording the relation between the thickness of the sample and the load up to failure. The Bureau has recently completed a detailed study of this test. The results are described in the April number of the Journal of Research (RP674), in which the conclusion is reached that the compression cutting test is valuable as a supplement rather than as a substitute for tensile strength and stretch tests.

CARBONIZATION ON WOOL

The object of the carbonization process is the removal of vegetable matter from wool. The wool is impregnated with a solution of sulphuric acid, squeezed or centrifuged to remove the adhering acid liquor, dried at about 71 C (160 F), baked at about 121 C (250 F), and finally washed or neutralized. The control of the process to avoid damage to the wool must be considered as one of its important phases. It is probable that many, if not all, of the troubles in the subsequent processing of wool that are attributable to faulty carbonization arise from incipient damage to the wool.

A considerable amount of acid is absorbed by the wool in the carbonization process. A knowledge of the nature of the wool–acid combination and the effect of the variables concerned is obviously basic to the control of carbonization. It is of importance from the standpoint of subsequent processing of the wool fiber; for example, dyeing from acid solutions.

The purpose of a cooperative study by the Bureau and the American Association of Textile Chemists and Colorists was to provide quantitative data on the system wool—sulphuric–acid—water under conditions similar to those in the soaking, drying, and baking of wool in the carbonization process as a basis for the effective study of mill problems relating to the process. This work is described in the April number of the Journal of Research (RP673).

The amount of sulphuric acid absorbed by wool from 0.1, 1, and 5 percent solutions at 22 C (72 F) and from a 5 percent solutian at 35 C (95 F), and the rates of absorption are reported. It was found that wool treated with acid retains less moisture than similar wool treated only with water when dried in air of relative humidities 6, 30, 65, and 90 percent; the difference in the amount of water absorbed being greatest for the 30 and 65 percent relative humidities. When the dried wool is baked there is a critical moisture content for each concentration of acid in the wool, above which the breaking strength of the wool decreases and the ammonia nitrogen content increases. The physical and chemical breakdown increases with an increase in concentration of acid and with an increase in the temperature of baking. The deterioration takes places in the first few minutes of baking.

When acid-treated wool is stored in air of 65 percent relative humidity or less, there is no decrease in breaking strength, but there is chemical deterioration, as evidenced by the ammonia nitrogen content, which increases with time of storage. The higher the relative humidity of the atmosphere in which the wool is stored and the greater the concentration of acid in the wool, the more rapid is the increase in ammonia nitrogen content.

That the deterioration of wool in baking is promoted by the presence of oxygen, moisture, and sulphuric acid is demonstrated in experiments in sealed tubes.

The nature of the system wool—sulphuric-acid — water is discussed. Mechanisms by which moisture and acid may be taken up and held by wool are suggested.

This project was made possible by a grant from the Textile Foundation Incorporated to the American Association of Textile Chemists and Colorists, and it is believed the results obtained will be of considerable value to the wool-processing industry.

COMMERCIAL STANDARD FOR HOSIERY LENGTHS

Commercial Standard CS46–33 for hosiery lengths, which is now available in printed form, was established to provide standard measurements and standard methods of measuring various types of men's, women's, and children's hosiery as a basis of understanding among producers, distributors, and users. It is also intended to eliminate confusion resulting from a diversity of measurements and methods, and to provide a uniform basis for guaranteeing full-length hose.

The specification embraced in this commercial standard covers methods of measuring, lengths, and tolerances for ladies' full-fashioned and seamless hosiery; ladies' ribbed cotton hosiery; men's, boys' golf, children's and misses' ribbed, children's ⅝ flat knit, and ⅞ hosiery; infants' ribbed hosiery; and children's socks. There is also included standard folded cuff lengths for infants' and children's anklets, boys' golf hose, and children's ⅞ hosiery.

For the convenience of the manufacturer the number of needles and size of cylinder recommended for use in knitting the various types of children's hosiery, infants' and children's socks, and boys' golf hose are included as a part of the specification.

The printed edition also carries a brief history of the activities connected with the development of this specification and its establishment as a commercial standard, which became effective July 1, 1933.

The standard also includes a list of official acceptors and a roster of the membership of the standing committee appointed by the general conference to review suggestions and comments with a view to revising the standard when necessary to keep it abreast of progress in the industry.

Copies of this Commercial Standard are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C., at 5 cents each.

SIMPLIFICATION OF PAPER CONES AND TUBES

Simplified Practice Recommendation R143–33 has been reaffirmed without change, other than the addition of a cone for asbestos roving. This addition will be incorporated in the recommendation when the book is reprinted.

This recommendation, which was proposed and developed by the industry, provides for the length, inside diameter, weight per thousand, color, and use of paper tubes, and for the length, inside diameter at base, taper, weight per thousand, traverse, use, and color of paper cones. These cones and tubes are used in the textile industry for winding warp and knitting yarns, silk, rayon, hosiery yarns, tire cord, thread packages, wire insulating yarn, asbestos roving, etc.

The reaffirmed recommendation with the additional cone became effective March 15, 1934.

WEAR OF DIES FOR EXTRUDING PLASTIC CLAY

Clays are highly abrasive and dies wear out rapidly when used for extruding clay bars for the manufacture of brick, tile, porcelain tubes, and other products. An investigation was undertaken to obtain information on the relative service values of 21 die materials when extruding stiff mud clays. The materials included a brass, a copper, 4 cast irons, 3 stainless steels, 5 specimens of heat treated chromium tool steel, a high carbon steel, a chromium-molybdenum steel, 3 chromium-cobalt-tungsten alloys, a nitrided steel, and a porcelain.

Before comparable results could be obtained it was necessary to determine the relation between pressure required to extrude the clay and abrasion loss, and also to determine the approximate taper to which the dies had to be made before consistent wear losses were obtainable.

The service value, or calculated relative length of service, of the dies ranged from 3.22 for a soft brass to 1673 for an alloy composed of chromium, cobalt, and tungsten. Dies of porcelain and dies of nitrided steel have hard outer portions or cases and decrease in service value as the outer portion is progressively removed by abrasion. In 12 tests the service value of a porcelain decreased from 107.2 for the first test to 66.3 for the twelfth at a depth of 0.116 mm (0.00457 in.) while nine tests of nitrided steel showed a decrease from 116.0 for the first test to 70.8 for the ninth at a depth of 0.140 mm (0.00551 in.). This investigation is reported at greater length in the April number of the Journal of Research (RP675).

THERMAL EXPANSIONS OF GLASSES

The value of glass for many practical purposes depends to some extent on the rate at which it expands when heated, and on the temperature to which it can be heated without undergoing a permanent deformation or some undesired change in properties.

A glass capable of withstanding relatively high temperatures and having a small expansion is generally more desirable for all purposes than a glass having one of these properties without the other because the field of usefulness of the first would be larger than that of the second.

Since both the resistance to deformation at high temperatures and the expansion of glass depend largely on its composition, a study, described in the Journal of Research for April (RP667), has been undertaken to see how these properties change with changes in composition. So far the work has embraced a study of only 49 soda-silica and soda-lime-silica glasses, all of which were specially made in a platinum crucible to avoid contamination. Determinations of the expansions and "softening points" of these glasses showed that the expansions from room temperature to the softening temperature varied from less than 6 to more than 9 parts per thousand as the proportion of soda and lime to silica increased, and the softening temperatures varied from more than 625 C (1,157 F) to less than 475 C (887 F) as the proportion of soda to silica and lime increased.

Curves are included from which one may determine the expansion and softening temperature of any glass of any composition in the range studied (50 to 80 percent silica, 17 to 50 percent soda, and 3 to 20 percent lime). The curves show that a number of glasses of very different compositions can have the same expansion, and likewise a number can have the same softening point, but there will be only one glass having a given expansion and softening point.

THERMAL EXPANSION OF ALPHA, BETA, AND ZETA ALUMINA

The values for linear thermal expansion were obtained by the interferometer method, using a heating rate of approximately 2 C per minute.

The alpha alumina was taken from a mass of special "white" corundum as manufactured for the abrasive industry. The beta alumina was furnished by the Norton Company, and was in the form of well-developed plates measuring as much as ½ inch in maximum dimension. The zeta alumina was made by H. B. Bartlett and obtained as relatively minute crystals, which were wetted with a dilute solution of aluminum chloride, specimens formed, and heated at 1,550 C. The determinations for the alpha and zeta forms therefore are not referred to any particular crystal axes, but gave average values. Furthermore, because of the extreme friability of the zeta alumina specimens and the consequent difficulty of obtaining accurate measurements of the height of the specimens, the data for this form are considered approximate only. The results are summarized in the table.

Form of Al_2O_3	Average coefficient of linear thermal expansion [a] for temperature ranges (degrees centigrade) of:					
	Room temperature to 200	200 to 300	300 to 400	400 to 500	500 to 600	600 to 700
Alpha	7.0	7.3	8.1	8.5	8.8	9.2
Beta [b]	5.1	6.2	6.0	5.8	5.7	[d] 6.0
Beta [c]	5.7	7.0	7.2	7.5	7.7	[d] 7.6
Zeta	6.0	7.1	7.7	8.8	8.5	[d] 7.7

[a] Values to be multiplied by 10^{-6}.
[b] Parallel to C axis.
[c] Perpendicular to C axis.
[d] Values to be questioned because of reaction between specimens and silica plates.

REACTION OF CALCIUM CHLORIDE ON PORTLAND CEMENT

Calcium chloride has been used for a number of years as an admixture in concrete. The Calcium Chloride Association has maintained a fellowship at the Bureau to study the reactions of calcium chloride with cement and their constituents, and to obtain more information concerning the effect of this material on concrete made from present-day cements. At present results have been secured only from short-time tests and include the effect of calcium chloride on the heat of hydration, setting time, strength, and consistency of a selected group of cements. From measurements of the temperature rise of a given mixture of cement and water during the first 24 hours, the quantity of heat evolved was calculated. The effect of the addition of calcium chloride was also determined, and from the analysis of the cements the heat contributed by the individual compounds was computed. The addition of calcium chloride appears to increase somewhat the heat contributed by dicalcium silicate and tetracalcium ferro-aluminate, and to decrease the heat from tricalcium aluminate. The heat contributed by tricalcium silicate shows very little change when calcium chloride is added. Calcium chloride increases the rate at which the heat is evolved from all cements tested. The setting time of 11 commercial cements, together with the spread of the set of these cements, was decreased as the amount of calcium chloride was increased. With each cement the flow, as determined with a flow table, was increased by the addition of calcium chloride. All percentages of calcium chloride produced increased strength over the plain concrete at all ages to 90 days, beyond which results have not yet been obtained.

TALC IN SAGGER BODIES

A short study of the effect of magnesium oxide, added either as pulverized talc or magnesite, on the physical properties of a sagger body included the determination of refractoriness as expressed in pyrometric cones, the linear thermal expansion, the modulus of elasticity and transverse strength at room temperature and at 625 C, the plastic deformation under load at 1,200 C, and the absorption. The results of studies already reported have led to the conclusion that information on those properties was the most significant when attempting to estimate the service life of sagger bodies.

Both talc and Grecian magnesite were tried in these tests to determine (1) whether it was the magnesium oxide which caused changes in certain of the physical properties of the body, and (2) whether the magnesium oxide could be added in the form of either talc or magnesite in order to obtain the desired results. The talc used contained approximately 11.5 percent wollastonite, 1.5 percent calcite, and the remainder magnesium silicate. The quantities of magnesite added to the body contained magnesium equivalent to the magnesium in the corresponding talc-containing bodies.

The PCE (softening point) of the commercial sagger body used in the test was 27–28 (approximately 1,610 C). When 2.5 percent talc was added

the PCE was 23; and with 5 percent talc 18–19 (1,500 C). Bodies containing corresponding amounts of magnesium but in the form of magnesite had a PCE of 26 (1,595 C) and 20–23 (1,550 C), respectively. The total linear thermal expansion in percent at 1,000 C for the magnesium-free body was 0.592; that with 2.5 percent talc 0.535; with 5 percent talc 0.462. Corresponding bodies containing the magnesite showed 0.525 and 0.470, respectively.

The modulus of elasticity at room temperature expressed in 1,000 lb/in^2 for the magnesium-free body was 1,125; for the 2.5 percent talc-containing body 765; the 5 percent talc 555; for the bodies containing equivalent percentages of magnesium but in the form of magnesite, 615 and 525, respectively. The modulus of rupture in lb/in^2 for these five bodies was 630, 615, 480, 475, and 515, respectively.

The total plastic deformations (in inches) at the end of 2½ hours, at a temperature of 1,200 C, and with a constant load of approximately 6 lb/in^2 placed at the center of a 1″ by 1″ by 9″ specimen over a 8-inch span, were as follows: sagger body without addition of talc or magnesite, 0.071; the 2.5 percent talc body 0.039; the 5 percent talc body 0.062; the corresponding magnesite-containing bodies 0.023 and 0.0235, respectively.

The absorption ranged between 14 and 15 percent, the lower value being obtained in the body containing 5 percent talc.

Gaging the service life of the sagger from the $\frac{\text{modulus of rupture}}{\text{modulus of elasticity}}$ values, together with the total linear expansion at 250 C, it was found that with respect to resistance to thermal shock any one of the bodies containing either added talc or magnesite should have a much longer life in service than the body containing none. Actual plant records on the 2.5 percent talc body in comparison with the talc-free body indicated the latter to have approximately one half the life of the former.

The plastic deformation (bulging of sagger bottoms) of the sagger body is decreased when measured under the conditions stated by the addition of either talc or magnesite to the body.

The limited amount of data obtained on the sagger body tend to show that (1) either talc or magnesite may advantageously be used in sagger bodies; (2) magnesite is preferable to talc; (3) 2.5 percent talc is probably more desirable than 5 percent, but the same does not hold true for magnesite.

The effect on the properties of a finished sagger will naturally depend on the type and purity of the talc or magnesite added to the body from which it is made.

NEW AND REVISED PUBLICATIONS ISSUED DURING MARCH 1934

Journal of Research[1]

Bureau of Standards Journal of Research, vol. 12, no. 3, March 1934 (RP nos. 653 to 655, inclusive). Price 25 cents. Obtainable by subscription.

Research Papers[1]

(Reprints from November and December 1933, and January and February 1934 Bureau of Standards Journal of Research.)

RP610. Spectral differentiation of pure hydrocarbons: A near infrared absorption study; U. Liddel and C. Kasper. Price 15 cents.

RP612. Wear resistance of natural stone flooring; D. W. Kessler. Price 5 cents.

RP613. Preparation and properties of aldonic acids and their lactones and basic calcium salts; H. S. Isbell and H. L. Frush. Price 5 cents.

RP616. Formula for specific volumes of saturated vapors; C. H. Meyers. Price 5 cents.

RP620. Comparison of natural aging of paper with accelerated aging by heating; R. H. Rasch and B. W. Scribner. Price 5 cents.

RP621. A radio direction finder for use on aircraft; W. S. Hinman, Jr. Price 5 cents.

RP622. The photographic emulsion: Sensitization by sodium sulphite; B. H. Carroll and D. Hubbard. Price 5 cents.

RP625. Critical study of the determination of ethane by combustion over platinum in the presence of excess oxygen; M. Shepherd and J. R. Branham. Price 5 cents.

RP628. Spectral reflectance of the Philippine Island Government standards for abaca fiber; G. Becker. Price 5 cents.

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[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D.C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents and $3.25, respectively.

RP630. Development of standard-frequency transmitting sets; L. Mickey and A. D. Martin. Price 5 cents.

RP631. Data on the spectral erythemic reaction of the untanned human skin to ultraviolet radiation; W. W. Coblentz and R. Stair. Price 5 cents.

RP633. Reactions of lithographic papers to variations in humidity and temperature; C. G. Weber and L. W. Snyder. Price 5 cents.

RP634. A glass electrode potentiometer system for the determination of the pH values of weakly buffered solutions such as natural and treated waters; J. O. Burton, H. Matheson, and S. F. Acree. Price 5 cents.

RP635. Analysis of wool-cotton textiles; R. T. Mease and D. A. Jessup. Price 5 cents.

RP636. A new cathode-ray oscillograph and its application to the study of power loss in dielectric materials; F. K. Harris. Price 5 cents.

RP637. Influence of neighboring structures on the wind pressure on tall buildings; C. L. Harris. Price 5 cents.

RP639. A method of adjusting the temperature coefficient and resistance of low-valued resistance standards; F. Wenner and James L. Thomas. Price 5 cents.

RP640. Wear of carpets; H. F. Schiefer and R. S. Cleveland. Price 5 cents.

RP641. A gamma-ray ionization chamber for use with a direct-current amplifier; L. F. Curtiss. Price 5 cents.

RP642. A sedimentation method for the determination of the particle size of finely divided materials (such as hydrated lime); D. L. Bishop. Price 5 cents.

RP646. The photographic emulsion: Notes on stability of finished plates; B. H. Carroll, D. Hubbard, and C. M. Kretchman. Price 5 cents.

RP647. A portable ultraviolet intensity meter, consisting of a balanced amplifier, photoelectric cell, and microammeter; W. W. Coblentz and R. Stair. Price 5 cents.

RP648. Note on phase equilibria in the system $Na_2O—TiO_2$; E. W. Washburn and E. N. Bunting. Price 5 cents.

RP649. Comparative efficiencies of various dehydrating agents used for drying gases (a survey of commercial drying agents); J. H. Bower. Price 5 cents.

RP650. Some physical properties of platinum-rhodium alloys; J. S. Acken. Price 5 cents.

RP652. Filters for producing the color of the equal-energy stimulus; R. Davis and K. S. Gibson. Price 5 cents.

Commercial Standards[1]

CS–33. Gage blanks. (2d edition.) Price 10 cents.

CS46–33. Hosiery lengths. Price 5 cents.

CS47–34. Marking of gold-filled and rolled-gold plate articles other than watchcases. Price 5 cents.

Technical News Bulletin[1]

Technical News Bulletin No. 203, March 1934. Price 5 cents. Obtainable by subscription.

LETTER CIRCULARS

It is the intent of the Bureau to distribute single copies of these Letter Circulars on request only to those parties having special interest in the individual Letter Circular. Economy necessitates limitation in the number of copies issued. It is not the intent to supply parties with a copy of each Letter Circular issued during the month. Letter Circulars are necessarily of a temporary nature designed to answer numerous inquiries on a given subject. Requests should be addressed to the Bureau of Standards.

LC404. Methods of using standard-frequency radio transmissions. (Replaces LC335.)

LC405. Testing machines for determining the strength and other properties of engineering materials in the laboratories of the National Bureau of Standards.

LC407. Automobile engine lubricating oils. (Replaces LC320.)

OUTSIDE PUBLICATIONS[2]

Obold, W. L., Hoffheins, F. M., Ingberg, S. H., and James, L. H., Heating and ignition tests with jute, National Fire Protection Association (60 Batterymarch St., Boston, Mass.), March 1934.

Phelps, F. P., Isbell, H. S., and Pigman, W., Mutarotation of β-d-ribose and β-e-ribose, Journal, American Chemical Society (Mills Building, Washington, D.C.), vol. 56, no. 3, p. 747, March 1934.

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[1] See footnote on preceding page.

[2] "Outside publications" are not for sale by the Government. Requests should be sent direct to publishers.

Waters, C. E., The case of Deuterium, Science (The Science Press, Grand Central Terminal, New York, N.Y.), vol. 79, no. 2047, p. 271, March 23, 1934.

Mease, R. T., and Jessup, D. A., Analysis of wool-cotton textiles, American Dyestuff Reporter (90 William St., New York, N.Y.), vol. 23, pp. 159–160 and 185–189; March 26, 1934.

U. S. GOVERNMENT PRINTING OFFICE: 1934